Claims

1. A photonic device comprising:

a first section including a material adapted to interact with photons,

a second section including a material adapted to interact with photons,

with an area of said first section and an area of said second section abutting each other

characterized in that

at least a part of said first area and a part of said second area define a low temperature bonding area.

2. A photonic device according to claim 1, wherein said low temperature bonding area connects said first area and said second area mechanically and optically.

3. A photonic device according to claim 2, wherein said low temperature bonding area comprises a surface area of said first section and a surface area of said second section which are connected by means of a low temperature bonding method.

4. A photonic device according to claim 1, wherein said interaction with photons comprises one ore more interaction types of the group of interactions consisting of transmission of photons, reflection of photons, absorption of photons, generation of photons, emission of photons, wavelength conversion of photons, guiding of photons, diffraction of photons, refraction of photons, superimposing photons, generation of photon interference and linear, elliptic and

circular polarization of photons.

5. A photonic device according to claim 1, wherein said second section is a surface area between a first section and a third section.

6. A photonic device according to claim 1 wherein said first section comprises a block of glass with a waveguide and said second section comprises an optical fiber.

7. A photonic device according to claim 1, wherein said first material has at least a portion where an index of refraction is different from an index of refraction of at least a portion of said second material.

8. A photonic device according to claim 7, wherein said photonic device is a wave guide defined in a surface area of said first material and said waveguide is covered by said second material.

9. A photonic device according to claim 8, wherein an essentially two-dimensional optical chip is defined with waveguides connecting active and passive optical components.

10. A photonic device according to claim 7, wherein said waveguide is defined in a bulk area of the first material.

11. A photonic device according to claim 10, wherein said waveguide extends oblique to a surface of said first material.

12. A photonic device according to claim 10, wherein said waveguide in said first material is connected to a waveguide

extending in said second material.

13. A photonic device according to claim 10 wherein, an essentially three-dimensional optical chip is defined with waveguides connecting active and passive optical components.

14. A photonic device according to claim 13, wherein said first section comprises a waveguide extending in a bulk material and said second section comprises an optical fiber.

15. A photonic device according to claim 1, wherein said photonic device is a transmitter and said first section comprises a light source and said second section comprises a splitter for splitting a propagation path of photons emitted by the light source into a plurality of propagation paths.

16. A photonic device according to claim 15, wherein said splitter comprises a material adapted to amplify light from said light source.

17. A photonic device according to claim 16, wherein said material is an active phosphate laser glass.

18. A photonic device according to claim 15, wherein a distributed Bragg reflector is connected at least to one branch of the splitter.

19. A photonic device according to claim 15, wherein a modulator is connected to at least one branch of the splitter for modulating one element of the group consisting of a phase of photons, an intensity of photons and a polarization of photons, said photons being propagating through said modulator.

20. A photonic device according to claim 19, wherein a combiner is connected to the modulator for combining propagation paths of photons and providing a combined propagation path for the A photons.

21. A photonic device according to claim 20, wherein an optical amplifier is connected to the combiner for amplifying light which propagated through the combiner.

22. A photonic device according to claim 1, wherein said photonic device is a transmitter and said first section comprises a light source, said light source being an element of the group consisting of light emitting diodes, laser diodes, diode arrays, laser diode arrays, vertical cavity surface emitting lasers (VCSELs), arrays of vertical cavity surface emitting lasers (VCSELs) and glass based laser sources, and

said second section comprises an element of the group consisting of wave guides, optical fibers, beam splitters, Bragg reflectors, distributed Bragg reflectors, tunable Bragg reflectors, light modulators and wavelength dependent absorbers.

23. A photonic device according to claim 1, wherein said photonic device is an amplifier and said first section comprises a wavelength dependent splitter splitting different wavelength bands into different propagation paths and said second section comprises an amplifying material at least for one of the wavelength bands associated with one of the propagation paths of the wavelength dependent splitter.

24. A photonic device according to claim 23, wherein said wavelength dependent splitter splits light into a plurality of different wavelength bands each of the different wavelength bands associated with a different propagation path and said second section comprises a plurality of portions comprising an amplifying material associated with at least one of the wavelength bands associated.

25. A photonic device according to claim 24, wherein each of the portions comprising amplifying material contains a dopant being a rare earth element adapted in its amplifying characteristics to said associated wavelength band for amplifying light of the said associated wavelength band.

26. A photonic device according to claim 25, wherein each of the portions comprising amplifying material is optically pumped by a diode laser light source adapted to an absorption characteristic of said portion comprising amplifying material.

27. A photonic device according to claim 26, wherein said splitter is an arrayed waveguide grating and splits light into transmission bands essentially centered at 1,3 μm, 1,4 μm and 1,5 μm, said 1,3 μm transmission band being associated with a Praseodym doped Chalcogenide glass and said associated diode laser light source having a pump light wavelenghts centered at about 1020 nm, said 1,4 μm transmission band being associated with a Tm doped Fluoride glass and said associated diode laser light source having a pump light wavelenghts centered at about 800 nm and said 1,5 μm transmission band being associated with an Erbium doped Phosphate glass and said associated diode laser light source having a pump light wavelengths centered at about 980 nm.

28. A photonic device according to claim 23, wherein a combiner combines propagation paths extending through said plurality of portions comprising amplifying material and is connected to a waveguide for transmitting amplified light.

29. A photonic device according to one of claim 1, wherein said photonic device is an amplifier having a plurality of amplification portions comprising amplifying material and arranged serially in a direction of the propagation of light and wherein said first section comprises a first amplification portion and said second section comprises a second amplification portion.

30. A photonic device according to claim 29, wherein each of the amplifying materials is containing a dopant being a rare earth element adapted in its amplifying characteristics to an associated wavelength band for amplifying light of said associated wavelength band.

31. A photonic device according to claim 30, wherein each of the portions comprising amplifying material is optically pumped by a diode laser light source adapted to an absorption characteristic of said amplifying material.

32. A photonic device according to claim 29, wherein said plurality of amplification portions define and overall gain which has an increased gain over an extended wavelenght interval in comparison to one of the said amplification portions.

33. A photonic device according to claim 1, wherein said photonic device is a receiver and said first section

comprises a photo detector and said second section comprises at least a waveguide for guiding photons to the photo detector.

34. A photonic device according to claim 33, wherein said photo detector is a photo diode.

35. A photonic device according to claim 33, wherein said second section comprises an light amplifying material for amplification of photons propagating in said waveguide.

36. A photonic device according to claim 35, wherein said amplifying material comprises a rare earth dopant which is optically pumped by a light source.

37. A photonic device according to claim 36, wherein said optical pump light source is a laser diode pump laser.

38. A photonic device according to claim 37, wherein a waveguide section is connected with said amplifying material and wherein a photo diode is connected to a waveguide of said waveguide section for controlling a pump light intensity of a laser diode pump light source associated with said amplifying material.

39. A photonic device according to claim 1, wherein

said photonic device is an optical add drop multiplexer and

said first section comprises a demultiplexer for demultiplexing light into a plurality of propagation paths and

said second section comprises optical switching means for switching between light from the multiplexer and added

light,

said second section is connected to a multiplexer section for multiplexing light from a plurality of propagation paths to a single propagation path.

40. A photonic device according to claim 39, wherein said photonic device is an optical add drop multiplexer and said second section comprises a plurality of entrance ports for light to be added and a plurality of exit ports for light to be dropped, said light to be dropped being switched by said optical switching means to the exit ports.

41. A photonic device according to claim 39, wherein said switching means comprise Mach Zehnder type interferometers for essentially absorption free switching of the propagation direction of photons based on an alteration of the optical path length in at least one of the arms of the Mach Zehnder interferometer.

42. A photonic device according to claim 41, wherein said alteration of the optical path length of said at least one arm of the Mach Zehnder interferometer is introduced thermooptically.

43. A photonic device according to claim 41, wherein said alteration of the optical path length of said at least one arm of the Mach Zehnder interferometer is introduced electrooptically.

44. A photonic device according to claim 41, wherein said dropped light is amplified by an optical amplifier and said demultiplexed light is amplified by an optical amplifier.

45. A photonic device according to claim 1, wherein said photonic device has at least a first waveguide in said first section comprising a material having an index of refraction n_1 with a positive temperature coefficient $\partial n_1/\partial T$ and with at least second waveguide in said second section comprising a material having an index of refraction n_2 with a negative temperature coefficient $\partial n_2/\partial T$ said first and said second waveguides being optically connected to each other.

46. A photonic device according to claim 45, wherein an overall temperature coefficient of an effective index of refraction encountered by a photon propagating through the first and second waveguide is essentially temperature independent.

47. A photonic device according to claim 45, having a third section comprising a material having an index of refraction n3 with a positive temperature coefficient $\partial n/\partial T$ with a third waveguide in said third section optically connected to said second waveguide.

48. A photonic device according to claim 47, wherein an overall temperature coefficient of an effective index of refraction encountered by a photon propagating through the first, second and third waveguide is essentially temperature independent.

49. A photonic device according to claim 45, wherein said photonic device is a mutliplexer/demultiplexer comprising a plurality of first waveguides, a plurality of second waveguides and a plurality of third waveguides.

50. A photonic device according to claim 1, wherein at least one material adapted to interact with photons is not a phosphate glass.

List of Numerals

1 first embodiment of photonic device
2 optical substrate defining first section
3 upper surface of optical substrate 2
4 waveguide
5 second section
6 lower surface of second section 5
7 three-dimensional waveguide structure
8 optical fibre
9 cube
10 cube
11 cube
12 cube
13 cube
14 cube
15 waveguide
16 waveguide
17 front surface
18 front surface
19 branch of waveguide splitter
20 branch of waveguide splitter
21 branch of waveguide splitter
22 branch of waveguide splitter
23 bend in waveguide
24 bend in waveguide
25 connection to waveguide
26 connection to waveguide
27 waveguide
28 waveguide
29 optical fiber
30 optical fiber
31 waveguide
32 waveguide
33 optical fiber
34 first section of fourth embodiment
35 light source
36 second section of fourth embodiment
37 splitter
38 propagation path
39 propagation path
40 propagation path
41 propagation path
42 low temperature bonding area
43 Bragg grating
44 modulator
45 electrode pair
46 electrode pair
47 electrode pair

48	combiner
49	combined propagation path
50	optical amplifier
51	doped glass substrate
52	pump laser light source
53	optical fiber
54	low temperature bonding area
55	optical fiber
56	propagation path
57	propagation path
58	propagation path
59	wavelenght dependent splitter
60	optical amplifier
61	optical amplifier
62	optical amplifier
63	low temperature bonding area
64	combiner
65	combined propagation path
66	optical fiber
67	silicate glass body
68	light source
69	light source
70	light source
71	optical amplifier
72	optical amplifier
73	low temperature bonding area
74	optical fiber
75	low temperature bonding area
76	optical propagation path
77	pump light source
78	pump light source
79	photo detector
80	photo detector
81	low temperature bonding area
82	optical fiber
83	photo diode
84	photo diode
85	photo diode
86	optical amplifier
87	optical amplifier
88	optical amplifier
89	optical fiber
90	arrayed waveguide grating
91	low temperature bonding area
92	optical propagation path
93	optical propagation path
94	optical propagation path
95	photo diode
96	photo diode

97 laser diode light source
98 laser diode light source
99 laser diode light source
100 photo diode

101 arrayed waveguide grating
102 optical fiber
103 propagation path
104 propagation path
105 propagation path
106 propagation path
107 Mach Zehnder interferometer
108 Mach Zehnder interferometer
109 Mach Zehnder interferometer
110 Mach Zehnder interferometer
111 propagation path
112 propagation path
113 propagation path
114 propagation path
115 passive glass of Mach Zehnder interferometer
116 passive glass of Mach Zehnder interferometer
117 thermooptical glass or electrooptical material
118 branch of Mach Zehnder interferometer
119 branch of Mach Zehnder interferometer
120 exit of Mach Zehnder interferometer
121 exit of Mach Zehnder interferometer
122 drop signal propagation path
123 drop signal propagation path
124 drop signal propagation path
125 propagation path to combiner
126 propagation path to combiner
127 propagation path to combiner
128 propagation path to combiner
129 propagation path to combiner
130 combiner
131 optical amplifier
132 optical fiber
133 optical fiber
134 coupler/splitter
135 first array of waveguides in first section
136 second array of waveguides in second section
137 third array of waveguides in third section
138 coupler/combiner
139 optical fiber
140 optical fiber
141 optical fiber
142 optical fiber
143 low temperature bonding area
144 low temperature bonding area